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TRANSACTIONS.

THE Kansas Academy of Science met in its twentieth annual session, at Topeka, in Representative Hall, on the afternoon of the 26th, and continued in session through the 27th and 28th of October, 1887. The following extracts from the proceedings are deemed of public interest.

Section 3 of the Constitution of the Academy was amended by the addition, to the sentence relating to the annual memberships, of the following: "but the Secretary and Treasurer of the Academy shall be exempt from the payment of dues during the years of their service."

The announcement by the Smithsonian Institution of the death of Professor Spencer Fullerton Baird, late Secretary of that Institution, was read, and in connection therewith the following resolution was adopted:

> "*Whereas*, Official information has been received of the death of Spencer Fullerton Baird, LL.D., the Secretary of the Smithsonian Institution and Director of the National Museum:
>
> "*Resolved*, That we, the officers and members of the Kansas Academy of Science, hereby express our sense of the great loss sustained by the Nation in the death of this eminent naturalist. We gratefully acknowledge the great value of his personal achievements in scientific pursuits, and the still greater value of the stimulus afforded by him to thousands of younger students of nature in all parts of the land. His untiring and unselfish energy will ever command the admiration and increase the activity of the members of this Academy.
>
> "*Resolved*, That the Secretary of this Academy be instructed to forward a copy of these resolutions to Professor S. P. Langley, Acting Secretary of the Smithsonian Institution."

A committee, appointed at a previous meeting to collect for preservation in the library of the Academy the photographic portraits of members, exhibited twenty-nine portraits, mostly of older members, some of whom are now dead, or removed from the State.

Officers for the ensuing year were elected as follows: President, J. R. Mead; Vice Presidents, E. H. S. Bailey, and T. H. Dinsmore, Jr.; Secretary, E. A. Popenoe; Treasurer, I. D. Graham; Librarian, B. B. Smyth; Curators, A. H. Thompson, N. S. Goss, H. W. Birchmore, Robert Hay, and E. A. Kilian. The names of seventeen persons were added to the roll of active members, and two persons resigned their membership.

The evening sessions were occupied: the first, by the address of the retiring President, Rev. John D. Parker, U. S. A., upon "Progress in Astronomy;" the second, by the lecture of Professor Lucien I. Blake, of the University of Kansas, upon "Practical Electricity and the Laws of Energy;" and the third, by the address of Chancellor H. W. Everest, of Garfield University, upon "The Utilization of Mental Power." At other sessions were presented among others the following papers:

HORIZON OF THE DACOTAH LIGNITE.

BY PROF. ROBERT HAY, JUNCTION CITY.

In various parts of middle Kansas a poor quality of coal has been in use for many years. It has been found at its outcrop, and worked by tunnels or drifts. It has also been worked by shafts in several districts. These shafts are nowhere very deep; fifty and sixty feet being extreme depths. These beds of so-called coal are really lignite, woody fiber being observable in nearly every specimen. The seams vary from two to twenty-eight or thirty inches thick. They have various qualities, some approaching in texture and value the true coal of the eastern part of the State, but the greater part is much inferior, yielding much ash after combustion. Some is little better than carbonaceous shale, which would yield gas or oil by distillation. The localities where lignite of a usable quality is obtained in workable veins of ten inches and upwards are limited in extent, but are widely distributed, in Russell, Ellsworth, Lincoln, Mitchell and Republic counties. The carbonaceous shales have have been found as far south as Barber county and as far west as Hodgeman and Hamilton counties.

All these seams are contained in rocks of the Lower Cretaceous period. They belong to the same series of strata that contain the remarkable dicotyledonous leaves for which Middle Kansas has become famous. This is the Dacotah Group.

Years ago Prof. Mudge suggested that the lignite beds of several of these counties were probably of the same horizon. Three years ago the present writer in a paper read to the Academy suggested the desirability of verifying or otherwise determining this conclusion. A recent paper by Prof. St. John indicates that he thinks of the veins of the various localities as constituting one horizon, though he has not given its position. We are not aware of anyone who has defined this horizon.

Within the last three years, and notably within the last twelve months, the writer has made numerous excursions into the regions where the lignite is developed; some journeys being made specially to examine its outcrop and find its horizon. The results are of the most definite kind, and it is probable that their publication will be of economic value.

The Dacotah sandstones are seen resting on Permian (Permo-Carboniferous) formations near the Little Blue River at the north line of the State. The contact of these groups is seen at various other points in an irregular curve extending through Clay, Dickinson, Saline and McPherson counties to the southwest, but hidden by superficial deposits on the high prairie and in the Arkansas valley. Near this easterly boundary of the Cretaceous rocks there has been no important discovery of lignite. The lignite deposits in Republic, Jewell, Lincoln, Ellsworth and Russell counties are from thirty to fifty miles from the eastern Cretaceous frontier. Another series of rocks is becoming manifest in the topography of the country. The hill-tops and sides show level ledges of limestone from three to thirty inches thick. In some regions — *e. g.*, in mid-Lincoln county — there are five of these ledges separated by layers of limy shale. Some soft and friable, some slaty and hard. These limestones and their intercalated shales constitute the Fort Benton Group, and lie above the sandstones and colored shales of the Dacotah. It is within sight of these Benton limestones and within a short distance vertically below them that the seams of lignite occur. In one or two instances the same seam is apparently continuous for several miles. Besides this, further to the south in the northwest corner of Barber county, and in parts of Hodgeman and Hamilton counties, a black lignitic shale is found in persistent beds of about the same thickness as the main seams of the lignite in the other counties. These also are in the same relation to so-called magnesian limestone ledges of the Benton. In the southwest there are large areas covered by superficial deposits — the two tertiary formations and more recent gravels and clays. It is quite possible that in some of these areas the lignitic horizon may be not far from the surface, and instead of the shale may yield a usable variety of lignite coal.

There is no doubt that the lignites and carbonaceous shales are practically at one level. They form an horizon very nearly at the top of the Dacotah Group. In no case is the main seam fifty feet below the base of the Benton, and it may always be relied upon, when present, within one hundred feet below the lowest Benton ledges of limestone. In some cases the lignite is within twenty or thirty feet of Benton limestones, but usually the shale over the coal gradually loses its carbonaceous and acquires calcareous qualities upwards for forty or fifty feet before a limestone ledge is fully developed. In a few cases, notably on the Smoky river and Coal creek, southwest of Wilson, a ledge of sandstone from 20 to 24 inches thick is developed over the main lignite seam. But even here other thin seams of lignite occur above this sandstone ledge, and the inclosing shales shade upward into the Benton.

The Benton limestones have a decided faunal character (*Inoceramus problematicus*, Belemnites and Nautilus being characteristic), and the slaty shales show this sometimes before the limestones are reached. In places the highest (the two feet above mentioned) sandstone ledge has the characteristic Dacotah leaves. Salix has been found in this ledge on Saw-Log creek in Hodgeman county. There is a shell bed over the lignite in Barber county that appears to belong to the Benton, but a shell bed in a similar position in Hamilton county and one in Lincoln county appear to belong to the Dacotah by lithologic as well as paleontological characters.

It is certain, then, that this lignitic horizon is in the highest part of the Dacotah Group. As to its vegetable origin, we regard it as altogether belonging to the Dacotah; but it would appear as if the sinking of the land areas at this period became more rapid, and that the waters soon became the Benton seas that overflowed the old Dacotah forests, and through sandy and carbonaceous shales shaded off the Dacotah formations into limestones of the Benton. The Benton ledges lie so horizontal, and form such a marked feature of the topography of that region, that they are the best guides to the position of the lignitic horizon. Find the lowest of these ledges, and the lignite, *if present*, will be found within one hundred vertical feet below it.

The elevations between the valleys of the rivers rise from two to three hundred feet above the bed of the streams, and in Lincoln, Ellsworth, Mitchell and Republic counties the lowest ledges of the Benton show high up on the slopes, a greater thickness of this group being developed upward as we go west. In the valleys, the lower elevations have rounder and smoother outlines, being formed upon the sandstones and shales of the Dacotah, flanked by the more superficial deposits. In places the sandstones of the Dacotah are weathered into fantastic forms of caps, pulpits and pinnacles, but the general outline of the low hills is smooth and round. As we go up the valley of the Saline the upper, massive sandstone of the Dacotah approaches more nearly the bed of the stream, and between it and the Benton is situate the lignite horizon. Erosion has cut out the lignite from any place in the main valley in Saline and Lincoln counties. It has a very slight development some four or five miles from the Lincoln county line, where the valley is much narrower, in Russell county. It is far back up the valleys of the tributary creeks, where there is a considerable thickness of overlying Benton, that the lignite is developed in Lincoln county. The principal mines are located on branches of Spilman creek in the northwest, and on the headwaters of East Elkhorn in the south of that county, and over the line in Ellsworth county. At one of the shaft mines on Spilman creek the bed of coal averages two feet thick, and has above and below it from one to two feet of a stiff carbonaceous clay shale—"draw clay," as the miners call it. This is overlain and underlain by a yellowish-white sandstone, soft and friable, the line of contact of the sandstone and clay being sharp and well marked. This shaft is 57 feet to the coal. In the Spilman creek mines the coal (lignite) is said to pinch out into the hill. This would suggest a thickening of the seam, and probably of the shales and other soft beds, towards the valleys by virtue of the removal of pressure by erosion.

This fact is not yet verified sufficiently, but it is in accordance with correct theory. It is a negative fact in favor of this, that so far coal (lignite) has not been found (or only slight traces of it) in the borings that have been made from the levels of the high prairie through the Benton to the Dacotah, as in the artesian boring at Russell city.

If the Dacotah period was characterized by a shallow sea with sandbars and low islands and peninsulas, with these sub-aërial parts clothed with forest, and if the total deposit does not exceed five hundred feet in thickness, as Prof. Mudge gives, and as is very probable,* it would not be expected that carbonaceous deposits would be sufficient to give a bed of coal in the earlier half of the period. Where the deposits of dicotyledonous leaves extend through a considerable vertical mass, it would suggest the possibility of a lignitic deposit near. But this is not verified by observation. The famous deposits of leaves are not in the neighborhood of the lignite, and the thick, massive sandstones of the Dacotah are all below the horizon of the lignitic coal. That the sand deposits were not favorable to the fossilizing of organic forms is well known, and hence there are comparatively few occurrences of fossil wood in the Dacotah. In the lower beds of the Benton there is abundance of it. The specimens are calcareous petrifactions. It is manifest that they represent wood of the Dacotah period, probably of the lignitic horizon, water-logged and imbedded in the calcareous mud of the early Benton seas. There is none in the upper Benton.

There is one other fact that will possibly be of importance in the development of the lignitic horizon in southwest Kansas. In the area in which the Dacotah is known in Kansas there is undoubtedly a change of dip from westerly to easterly in the great body of the formations. We have previously pointed out that this would have a bearing on the water supply of western Kansas, and recent artesian borings at Coolidge and Fowler confirm our judgment. In the Arkansas valley and further south it will have a bearing on the probable supply of lignite for fuel or use in sugar manufacture, for which Prof. Swenson has pointed out its value. The easterly dip of the strata in the valley of the great river is not much different from the slope of the stream. The effect of this is to keep the lignitic horizon not far from the surface over an immense area. In a part of the southwest the cretaceous formations are hidden by the two tertiary deposits, and it may be that they have, by preventing percolation and by added pressure, preserved areas of lignite of better quality than any yet found. Of course the drill only can settle this, but the areas in which it is probable or possible can be approximately determined.

NOTE.—The published record of a drill-hole at Cawker City suggests some exception to be made to some of the conclusions of this paper; but there are some grounds to suspect the accuracy of that record, and in the absence of confirmatory evidence we leave the present discussion of its bearings. Recent discovery by Prof. Hill of another cretaceous horizon in Texas, and the Texan character of the shell bed in Barber county, suggest a possible change in the horizon of the southern lignite which must be determined by further investigation; but it is certain that the horizon exists in the Dacotah as black shale in the more western counties south of the Arkansas river, as Morton and Stanton.

ON THE NEWLY-DISCOVERED SALT BEDS IN ELLSWORTH COUNTY, KANSAS.

BY E. H. S. BAILEY, PH.D.

That there are salt beds underlying many portions of this State, seems to have been recognized for many years. Where deep wells have been sunk the flow of salt water is often abundant, and as we go farther west, the salt waters are nearer the sur-

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*The Russell boring does not give more than 375 feet for the thickness of the Dacotah.